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## **Durability of SOECs with modified electrodes**

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### **Abstract**

There is a huge potential in utilising solid oxide electrolysis cells (SOEC) due to the clean energy conversion, research in the field of Power-to-Liquid (PtL) and Power-to-Gas (PtG) is being pursued. However, performance and durability still needs to be improved by reducing the degradation of such cells for a large-scale commercialization of the SOEC technology. To reduce the area specific resistance (ASR) and increase the durability, a further optimization of interfaces between electrolytes and electrodes is needed. In this context, the minimization of oxygen reduction reaction resistance is interesting. One of the approaches is to create a large surface area in form of a backbone structure, followed by infiltration of the electron /oxygen conducting component. In such a way, the triple phase boundary (TPB) is increased which should lead to better performance and durability. Another approach at reducing cell degradation is to modify the fuel electrode which contributes significantly to the ASR, by improving the particle size distribution.

In this work, a fuel electrode consisting of Nickle-Yttria stabilized Zirconia (Ni:YSZ) supported SOEC with YSZ electrolyte and Ceria doped Gandolinium Oxide (CGO) porous oxygen electrode backbone was infiltrated with Lanthanum Strontium Cobaltate (LSC). The obtained SOEC was characterized in detail both for the initial performance and the durability over 500 hours of operation in potentiostatic mode. Simultaneously, improvement of the fuel electrode was investigated. This cell was tested for over 1000 hours of operation in potentiostatic mode. This mode was chosen because it is interesting from system point of view by the ability to operate at thermoneutral voltage. The cell with infiltrated oxygen electrode showed worse performance, while the cell with improved fuel electrode showed significantly better performance than State-of-the art (SoA) cell. The electrochemical impedance results were related to observations from the micro structural analysis.